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Title of the Invention:

METHOD OF MANUFACTURE
MANUFACTURING MEHTOD OF STRUCTURAL BODY AND STRUCTURAL BODY

Background of the Invention:

<Technical Field to which the Invention Belongs>

The present invention relates to a method of manufacturing a unitary structural body one by joining body members without a gap, from plural forming products by joining having a flange to an end portion to an end portion of one plate and another plate, and, in particular, the invention relates to a method of manufacture suitable for production of an end structure for constituting an end portion of a railway vehicle.

<Prior Art>

As shown in Japanese patent No. 2,692,459 (USP No. 5,488,770), a car body of a railway vehicle typically has a hexahedron-shaped body. An end portion of the railway vehicle in the longitudinal direction is referred to as an end structure. To the end structure, a passage or door is provided for coming and going allowing passengers to come and go to an adjacent car body is provided.

For this reason, the end structure necessaries requires two plates for constituting a right side panel on the side of the passage and a left side panel on the side of the passage and a plate for constituting a panel above an upper portion of the passage. Since the three plates join a roof structural body member and a side structural body member, to the end portion of the outer side edges of the three plates each have respectively the a flange. Further, the end portions of the three plates have the reinforcement use flanges.

In the prior art, the forming product having the flange to the end portion of the plate is manufactured by the press manner in which the plate is placed between a female die and a male die. Since the female die and the male die are necessitated and then it becomes the high cost.

For the above reason, to the respective plate L-shaped plates is welded according to a spot welding manner and one side of L-shaped plate is formed as the above-stated flange.

As a means for lessening the metal die, a forming method has proposed, as shown in from Fig. 18 to Fig. 20 of Japanese application patent laid-open publication No. Hei 11-310,371. In this method, to the female die, an outer peripheral portion of a row material is fixed and the row material is pushed in according a rod-shaped tool and along to an inner peripheral face of the female die. The tool is moved and the plate is carried out incrementally a buckling processing.

On the other hand, in Japanese application patent laid-open publication No. Hei 10-76,321, a squeezing processing is carried out incrementally.

A construction shown in Fig. 13 will be explained, To three plates 1, 2, 3, after flanges 1b, 1c, 1d, 2b, 2c, 2d, 3b, 3c, 3d have provided. The flanges 1b, 2b of the right and the left plates 1, 2 are overlapped, and these flanges 1a, 2b are carried out according to the spot welding and are formed as one body. The flanges is provided as one body by bending the plates 1, 2, 3. Further, the

flanges 1c, 3c, 2c are overlapped to a roof structural body 30 and welded.

A reference numeral 45 is a passenger of passengers. The respective three plates 1, 2, 3 are continued to the adjacent flange and a connection portion has a circular arc shape. In this case, to a joining portion between the right and the left plates 1, 3, the central plate 2 and the roof structural body 30, a space exists. This space must be closed with another plate to prevent the entering the rain, water etc. The closing work requires the high cost. Further, an outer appearance becomes bad.

Further, the flange is formed by bending the plate, a cross-section thereof has the circular arc shape. For this reason, a groove is provided between the right and left plates, accordingly the outer appearance becomes bad.

In the incremental forming method, since the metal die is made by one die, the manufacture can be carried out with the low cost. However, in the incremental forming method, as shown in the above-stated Japanese application patent laid-open publication Hei 11-310,371, to the end portion the flange is formed, but the plate is left on the outer peripheral portion of the flange. In a case where the plate is unnecessary, it is necessary to cut off and remove the outer peripheral portion of the flange.

Further, according to this incremental forming method, when the flange is formed, the angle by making the flange and the bottom plate is not made with the right angle,

however it works. For example, when a cylinder is joined by overlapping the flange, the flange has right angle, it can hardly to carry out overlapping joining.

Further, it is difficult to form flange having the high height. For this reason, to the flange it is difficult to overlap another member and a flange of the another member.

On the other hand, according to the processing method shown in the above-stated Japanese application patent laid-open publication No. Hei 10-76,321, when the flange is processed, the wrinkle can occur easily in the joining portion between the flange and the flange.

Summary of the Invention:

An object of the present invention resides in that, when two plates having a flange and a third plate are joined, an occurrence of a space in a joining portion can be prevented.

The above-stated object can be attained by a manufacturing method of a structural body, manufacturing a first plate and a second plate for abutting and welding the first plate, the first plate comprising a first flange provided by bending a first side of the first plate, a second flange being orthogonal substantially to the first flange and provided by bending a second side of the first plate, and a recessed portion except for a flange between an end portion in a longitudinal direction of the first

flange and an end portion in a longitudinal direction of the second flange, the second plate comprising a third flange provided by bending a first side of the second plate and for connecting the end portion in the longitudinal direction of the first flange, and a raised portion which protrudes from a third side, which is substantially orthogonal to the first side and a second side being parallel substantially to the first side and in an end portion in a longitudinal direction of the third flange and in a vicinity of the end portion, abutting the end portion in the longitudinal direction of the first flange and the end portion of the longitudinal direction of the third flange, abutting the third side to an outer side of a circular arc of the second flange from the first plate; inserting and abutting the raised portion to the recessed portion; and welding the respective abutted portions.

Brief Description of the Drawings:

Fig. 1 is a plan view of an end structure of a car body representing one embodiment according to the present invention;

Fig. 2 is a cross-sectional view taken along line II-II in Fig. 1;

Fig. 3 is a cross-sectional view taken along line III-III in Fig. 1;

Fig. 4 is an enlarged view of a portion IV in Fig. 1;

Fig. 5 is a cross-sectional view taken along line V-V in Fig. 4;

Fig. 6 is a perspective view of an end structure of a car body representing one embodiment according to the present

invention;

Fig. 7 is a longitudinal cross-sectional view of an essential portion of an increment forming apparatus;

Fig. 8 is a plan view between a flange 52b and a flange 52c in a midway of the forming;

Fig. 9 is a plan view of an end portion in a longitudinal direction of a flange in a midway of the forming;

Fig. 10 is a plan view of a circular arc portion in a midway of the forming;

Fig. 11 is a front face view of an end structure of a car body of another embodiment according to the present invention;

Fig. 12 is XII-XII cross-sectional view of Fig. 11; and

Fig. 13 is a view corresponding to Fig. 1 in the prior art.

Description of the Invention:

A first embodiment of a manufacturing method of a structural body according to the present invention will be explained referring from Fig. 1 to Fig. 12. Fig. 1 shows mainly a left half portion of a car body. The car body comprises a stand flame 10 for constituting a floor, a side structural body 20 for constituting a side face, a roof struqural body 30, and an end structural body 40 for closing an end portion of the car body.

As seen in Fig. 1,

The end structural body 40 comprises a passage 45 for the passengers, a plate 50 for constituting a left side thereof, a plate 60 for constituting a right side thereof, and a plate 70 for constituting an upper portion above of the passage 45.

The right and the left plates 50 and 60 are of substantially quadrangular shape, and to the edge portions, except for the bottom edge of each a side of a lower end of the plate, flanges 52b, 52c, 52d, 62b, 62c, 62d are provided. The flange 52b (62b) is a flange which is on one side of the passage 45. The flange 52c (62c) is a flange which overlaps to the roof structural body 30. The flanges 52d, 52e (62d, 62e) are flanges which overlap to the side structural body 20.

At a joining portion disposed between of the an upper end of the vertical flange 52b (62b) and the end of flange 52c (62c) of the upper side, no flange is provided. The two flanges form a non-continuous portion in which no flange is provided. As seen in Fig. 4, but a portion of a bottom plate 51 (61) is excepted cut out, and a quadrangular-shaped recessed portion 53 (63) is provided formed thereby. The size of the recessed portion 53 (63) will be described later in a latter portion.

The plate 70 for constituting the upper portion above of the passage 45 for the passengers is of substantially quadrangular shape and has flanges 72b and 72c along in the lower side and the upper side, respectively, as seen in Fig. 3. The flange 72c is the flange mounted so that it which overlaps to the roof structural body 30.

As seen in Fig. 5, End portions on the of a left side 71b and a right side 71c

of the plate 70 are abutted to a bent circular arc-shaped outer face in which the flange 52b (62b) protrudes from the bottom plate 51 (61). This abutted portion is carried out the welding. The bottom plate 51 (61) of the plate 50 (60) is the same face of a bottom plate 71. Further, this abutting welding is called s as a fillet welding manner.

The right and the left end portions of the flange 72c and the plate in the vicinity of the flange provide raised portions 73, 73 which enter the recessed portion 53 (63) of the plate 50 (60). An abutted portion between the recessed portion 53 (63) of the raised portion 73, 73 is welded. An upper side of the raised portions 73, 73, forms the flange 72c. The flange 52c (62c) and the longitudinal direction end portion of the flange 72c are abutted and welded.

The longitudinal direction end portions of a lower side 72b of the plate 70 is abutted to the flanges 52b, 62b and welded. An end portion of the bottom plate 71 between the raised portions 73 and the flange 72b protrudes from the longitudinal direction end portion of the flange 72b.

The abutted portions in above are welded continuously and no water leakage occurs. The welding portions are cut off by a grinding manner and are formed smoothly.

The flange 52e (62e) of the connection portion between the flange 52c (62c) and the flange 52d (62d), forms a circular arc shape.

The protrusion directions of the flanges 52b, 52c, 52d, 52e, 62b, 62c, 62d, 62e, 70b, 70c are orthogonal

substantially to the faces of the bottom plates portions 51, 61, 71. Accordingly, when the flanges 52c, 52d, 52e, 62c, 62d, 62e, 70c are overlapped to an inner side of the end portions of the a side structural body 20 and the roof structural body 30, they overlap in parallel and the so that good welding can be attained. The lower ends of the right and the left plates 50, 60 are overlapped to on the stand frame 10 and are welded.

The plates 50, 60, 70 have a plurality of reinforcement use ribs in on the inner side of the car body and in on the outer side of the car body, but they are not shown in the figure. For example, the a rib is may be formed of another member spot welded to with the plates 50, 60, 70 the spot welding manner is carried out. Further, the plates 50, 60, 70 are provided integrally by the plastic processing.

According to the above, to the joining at the joint portion between the plate 70, the plate 50 (60) and the roof structural body 30, there is no gap and then the after joining is carried out. Further, in to the joining portion joint between the plate 70 and the plate 50 (60), there is no circular arc-shaped groove of the flange and so that the a good outer appearance can be obtained.

Next, the method for of manufacturing the plates 50, 60 and 70 will be explained referring with reference to from Fig. 7 to Fig. 10. This plate manufacturing method is carried out according to the increment al forming method. Fig. 7 shows only a left end portion of the increment al forming apparatus. The other portions have suitably the same construction.

The forming of the plate 50 will be explained. A metal die 120 is a female die (an outer die). The female die 120 is placed horizontally. To an upper face of the female die 120, the plate 50 being the row material is mounted. In an interior portion of the female die 120, a rod-shaped tool 120 is inserted. The tool 130 descents along to a vertical face of the female die 120, and next it is moved along to an inner peripheral face of the female die 120. A shape of the inner peripheral face of the female die 120 is the same outer diameter shape of the plate 50.

When the tool 130 is carried out to go one round, the tool 130 repeats the above function. Accordingly, the flat plate 50b being the row material is carried out the squeezing processing. Further, the descendant of the tool 130 means the movement in the squeezing processing direction. This is substantially the movement in an axial direction of the tool 130 and is the movement in a depth direction of the forming product.

A tip end of the tool 130 is flat. A corner portion from the tip end to the side face of the tool 130 has a circular arc shape. The circular arc is a circular arc which is formed by a bottom plate 51 of the plate 50 and the flanges 52b, 52c, 52d. The tool 130 is lifted down rotatively from the movement body (not shown in figure) of the upper portion. The tool 130 moves along to an inner peripheral face (it corresponds to the portions of the flanges 52b, 52c, 52d) of the female die 120.

Since the tool 130 moves by contacting to the row material 50b, the tool 130 rotates (rotates on its axis) as a follower. Accordingly, the tool 130 is not contacted to at only one point of the row material 50b, a blazing phenomenon can be prevented. Further, a lubricating oil is coated on the upper face of the row material 50b.

On the upper face of the female die 120, plural positioning use pins (guides) 123 are stood up. When the flat plate of the row material 50b is placed on the upper end of the female die 120, the pins 123 contact to the outer peripheral portion of the row material 50b. Then the positioning is carried out. The upper end (it is called as a shoulder portion) of the inner peripheral side of the female die 120 has a circular arc. This circular arc exists along the whole periphery of the female die 120.

According to this circular arc, the outer peripheral portion of the row material 50b moves smoothly in the inner peripheral side of the female die 120. Further, the position etc. of the circular arc portion of the shoulder portion of the female die 120 will be described in a latter portion.

The interior portion of the female die 120 has no bottom portion. In the interior portion of the female die 120, a seat 140 for mounting the row material 50b is provided. The seat 140 is supported according to a means 150 which can carry out to control the height position thereof. The seat 140 is provided on a portion which

opposes to a tip portion (a lower end) of the tool 130. The seat 140 is provided on a portion which corresponds to a move track in the peripheral direction of the tool 130. Namely, the row material 50b is sandwiched by the tip end of the tool 130 and the seat 140. Further, the seat 140 is provided on a central portion of the female die 120. Accordingly, the central portion of the row material 50b can be fixed.

The seat 140 mounts the row material 50b and fixes it. The fixing is carried out according to the magnetic force by providing an electromagnet. Or, on an upper face of the seat 140, a vacuum adsorption pad is provided and the fixing is carried out according to a vacuum adsorption. A fixing position is a central portion of the seat 140. The row material 50b is made of a steel system metal, a stainless system metal, and an aluminum alloy system metal.

The means 150 for ascending and descending the seat 140 will be explained. The means 150 is comprised of plural screw mechanisms 151. In Fig. 7, a pair of the screw mechanisms 151 is shown. A seat 145 of a lower end of the seat 140 is supported according to a screw rod 152. To the seat 145, a rotatable free nut is provided. According to the rotation of a drive mechanism 155, the screw 152 rotates and the seat 140 descends. Further, between the seat 140 or the seat 145 and a base, plural guides (not shown in figure) for ascending and descending vertically the seat 140 are provided. The means 150 and

the female die 120 are installed on the base.

The forming method will be explained. The material 50b is a flat plate, which is developed as after the forming. In the above-stated development, the development size is calculated according to the surface area and the volume of the forming product, similar to the squeezing forming method of the corner portion. Or, it is determined according to the experimentation.

Under the base of the development size, the plate is cut off using a tartlet punch press manner etc. A, connection portion between the flange 52b and the flange 52c is separated. Further, the recessed portion 53 is provided. The development shape of the material 50b is determined according to the above-stated facts.

Next, the material 50b is mounted on the upper end of the female die 120. In this time, the material 50b is mounted on the ascended seat 140. The row material 50b is positioned determined by a pins 123.

Next, the material 50b is fixed to the seat 140. The fixture position and the fixture means are stated on the former portion.

Next, the seat 140 is descended and next the tool 130 is descended. A descendent position of the tool 130 is a position where between the side face of the tool 130 and the vertical face (the inner peripheral face, the linear portion) of the female die 120, the material 50b is positioned.

Namely, the row material 50b is sandwiched between the inner peripheral face of the female die 120 and the side face of the tool 130. Under this condition, the tool 130 is descended and as stated in a latter portion the tool 130 is moved circumferentially in the peripheral direction along the inner peripheral face of the female die 120. A descendent amount of the tool 130 is one where a tip end of the tool 130 contacts to the descendent row material 50b.

For example, before the descendent of the seat 140, when the upper face of the seat 140 is positioned at the same face of the upper face (the position where the end portion of the row material 50b is mounted on) of the female die 120, when the tip end of the tool 130 is in contact with the upper face of the row material 50b, the descended amounts of the seat 140 and the tool 130 are the same amount. Both of the seat 140 and the tool 130 can be descended at the same time.

As shown in this embodiment according to the present invention, when the bottom plate 51 is wide and the plate thickness is thin and the central portion of the bottom plate 51 is fixed, since the bottom plate 51 is bent, it is unnecessary to bend the outer peripheral portion of the bottom plate 51 according to the female die 120. Accordingly, the row material 50b may become to incline. Further, as stated in a latter portion, when the tool 130 is moved in the peripheral direction, the row material 50b may become to rotate. Accordingly, the row material 50b is

fixed to the seat 140.

The descendent position of the tool 130 is a position in which between the side face of the tool 130 and the inner peripheral face of the female die 120 the flanges 52b, 52c and 52d are positioned. Further, it is taken into the consideration about the rectangular angle of the flanges 52b, 52c, 52d. When the rectangular angle is taken into the consideration, the tool 130 is positioned to sandwich the row material 50b between the side face of the tool 130 and the inner peripheral face of the female die 120.

Next, the tool 130 is moved along to the inner peripheral face of the female die 120. The tool 130 rotates as a follower. The row material 50b is formed incrementally in accordance with the movement of the tool 130.

Next, Every time the tool 130 is moved around one periphery, as stated in above, the seat 140 is descended and also the tool 130 is descended. The descendent amounts of the tool and the seat 140 and the descendent position of the tool 130 are the sated in above. Next, the tool 130 is moved along to the inner peripheral face of the female die 120.

Thereafter, the descendents of the seat 140 and the tool 130 and the movement in the peripheral direction of the tool 130 are repeated. According to the repetition of the above-stated process, the outer peripheral portion of

the row material 50b is moved in the inner peripheral face of the female die 120. With this, the squeezing processing is carried out. The axial direction of the tool 130 is a squeezing processing direction. The movement direction of the tool 120 along to the inner peripheral face of the female die 120 is a radial direction of the tool 130.

According to this embodiment of the present invention, the row material 50b is deformed in a narrow portion between the female die 120 and the tool 130, since the small and homogeneous strain is given incrementally, the good flat face degree of the bottom plate 51 can be maintained.

In addition to the above, since the flanges 52b, 52c, 52d are formed by restraining extending over the all periphery thereof, the flanges 52b, 52c, 52d are not expanded in the outer side, the forming product having the superior rectangular degree of the flat plate portion and the flange portion can be manufactured.

In particular, since the circular arc-shaped flange of the connection portion between the flange 52c and the flange 52d is made wide to the outer side according to the forming, but since the flanges 52c, 52d are restrained to the outer portion by the female die 120, the vertical flanges 52c, 52d can be formed.

Namely, in the all range from the beginning of the squeezing process to the finish process, since the flange is sandwiched between the inner peripheral face of the

female die 120 and the side face of the tool 130, the squeezing processing can be carried out by restraining the flanges from the outer portion and from the inner portion. As a result, the processing having the accuracy with the rectangular degree etc. can be carried out.

As stated in above, in the incremental forming using the female die 120, the seat 140 is provided in the inner peripheral side of the female die 120 and to this seat 140, the row material 50b is fixed to, the row material 50b can be fixed to, and a predetermined forming can be attained. Further, as the forming proceeds, the flange is positioned in the vertical face of the female die 120.

Further, the end portion of the female die 120 is moved to direct for the inner peripheral face of the female die 120 and the squeezing processing is carried out, and, further, the end portion of the female die 120 is positioned in the inner peripheral face of the female die 120 and the squeezing processing is carried out. Accordingly, the good rectangular degree comprised of the flange and the bottom face 51 can be obtained. Further, the height of the flange can be formed large.

Further, since the end portion of the row material 50b is moved in the female die 120 and the squeezing processing is carried out, when the fatigue of the after forming of the row material 50b is taken into the consideration, after the forming, it is unnecessary to cut off the end portion of the flange.

Since the high load as shown in the press processing is not necessary, the female die 120 can be formed with the easy material, such as the general steel material, the thermal treatment, such as the sintering, and the minute surface finishing, such as the press metal die, are not necessary.

The movement of the tool 130 will be explained in detail. The plate 50 has the flanges 52b, 52c, 52d in the three sides of the quadrangular shape and another one side no flange is provided. Accordingly, the circular arc portion of the shoulder portion of the female die 120 is provided along to the three sides. Another one side of the row material 50b is not mounted on the another one side of the female die 120. A gap is formed between the both.

The tool 130 moves to direct from the one end side of the flange 52b to the flange 52c, and, through the flange 52c, the tool 130 moves to direct to the end portion of the flange 52d. The move track of the tool 130 in the recessed portion 53 portion is shown in Fig. 7.

In Fig. 8, the tool 130 has moved along to the flange 52d and is passed through the end portion in the longitudinal direction of the flange 52d. Next, the row material 50b is moved reversibly a little to position in the lower portion of the tool 130. Next, the seat 140 and the tool 130 are descended. Next, the tool 130 is moved to reach the end portion in the longitudinal direction of the flange 52b through the flanges 52c, 52e, 52d, successively.

After the tool has passed the end portion of the flange 52b, as explained in Fig. 8, the material 50b is moved reversibly a little to position in the lower portion of the tool 130. Next, the seat 140 and the tool 130 are descended. Next, the tool 130 is moved to reach the end portion in the longitudinal direction of the flange 52d through the flanges 52b, 52e, 52d. Hereinafter, the above stated operation is repeated.

Further, since the flange of the plate 50 is provided only the three sides, the tool 130 is reciprocated as stated in above. The former explanations "the tool 130 is moved in the peripheral direction along the inner peripheral face of the female die 120" etc, include the case of the three sides. Further, the flange is provided only the three sides, it is unnecessary to reciprocate the tool 130 but it can go around.

After the tool 130 has passed through the end portion in the longitudinal direction of the flanges 52d, 52b, to move the tool 130, the end portion in the longitudinal direction of the flanges 52d, 52b is sandwiched between the side face of the tool 130 and the inner peripheral face of the female die 120 and the end portion in the longitudinal direction of the flanges is formed with a predetermined shape.

In the midway in the longitudinal direction of the flange, when the movement of the tool 130 is stopped, the end portion side from there is not the linear shape.

Between the end portion of the raw material 50b having no flange and the end portion of the female die 120, there is a gap having more than the radius of the tool 130. As the size of the above-stated recessed portion 53, it is necessary to have a space through which the tool 130 can be passed.

The connection portion between the flange 52b and the flange 52c is removed. Further, the recessed portion 53 is arranged at this location. The distance between the flange 52b and the flange 52c, namely, the size of the recessed portion 53, is determined so as to press the end portion in the longitudinal direction of the flanges 52b, 52c by using the side face of the tool 130 against the inner peripheral face of the female die 120. The tool 130 is moved by pressing the end portion in the longitudinal direction of the flanges 52b, 52c.

When the tool has moved from the flange 52b to the flange 52c, and the lower end of the tool 130 is in contact with the end face of the bottom plate 51, the tool 130 is raised a little and is moved to the side of the flange 52c and processed and after which, the tool 130 is again moved in the longitudinal direction of the flange. Namely, the tool 130 is moved as shown in Fig. 8.

The plate 60 is manufactured similarly. The plate 70 is manufactured similarly. The movement of the tool 130 in the end portion in the longitudinal direction of the flanges 72b, 72c is carried out similarly.

The processing machine for carrying out the incremental

forming is a numeric control system processing apparatus, for example, NC milling machine or a machining center. To a main shaft of the numeric control system processing apparatus, the tool 130 is installed. The tool 130 is moved along to the inner peripheral face of the female die 20 in the vertical direction by the numeric control.

The main shaft having the tool 130 is moved in the vertical direction and in one direction horizontal direction. The female die 120 and the seat 140 are mounted on the table (the base). The table is moved in the horizontal direction of the rectangular direction against the movement direction of the horizontal direction of the main shaft.

According the above-stated two movements, the tool 130 is moved along to the inner peripheral face of the female die 120. The ascending and descending means 150 is mounted on the table. In place of the movement in the vertical direction of the tool 130, the table can be ascended and descended.

The example will be explained. The diameter of the tool 130 is 25 mm, the plate thickness of the row material 50b is from 0.5 mm to 4 mm degree, the distance from the inner peripheral face of the female die 120 to the side face of the tool 130 is from 0.8 times to 2 times degree, and the push-in depth of one time of the tool 130 (the descendant amount of one time of the seat 140) is 0.5 time to 2 times of the plate thickness of the row material 50b.

Further, the height of the flange is 20 mm, the radius of the circular arc (the shoulder portion) of the female die 120 is 5.5-13.5 mm, the diameter of the tool 130 is 25 mm, the radius of the tip end of the tool 130 is from 5.5 mm to 10 mm, and the radius of the circular arc portion 52e is 100 mm.

The size of the material 50b will be explained. As shown in Fig. 7, the size of the material 50b is such that the end portion of the material 50b is positioned on the upper portion of the center of a circular arc R of the shoulder portion of the female die 120, or the end portion of the material 50b is positioned to the center side of the female die 120 from the upper portion of the above-stated center. When the size of the material 50b is larger than the above case, in the circular arc portion 12a of the flange 12, the crack occurs easily in the connection portion between the flange 12 and bottom plate 11.

In the above-stated embodiment according to the present invention, after the seat 140 is descended, the tool 130 is descended, however the seat 140 and the tool 130 can be descended at the same time. Further, the tip end of the tool 130 is not formed with the flat shape, but can be formed with a spherical shape. Further, the tool can be formed to not rotate.

The squeezing processing can be carried out by fixing the seat 140 and by ascending the female die 120. The tool

130 does not move in the vertical direction during the midway of the forming in this case. The seat 140 is positioned in the position in the axial direction of the tool 130 and is arranged along to the inner peripheral face of the female die 120.

Further, after the tool 130 goes around the circumference along to the circular arc portion of the shoulder portion of the female die 130, next the tool 130 is moved along the inner peripheral face of the female die 120, and next the tool 130 moves around the female die 120. After the end portion of the raw material is formed with a circular arc shape, and the tool 130 is lowered along to the inner peripheral face of the female die 120, accordingly, the height of the flange is made even further larger.

An embodiment according to the present invention, as shown in Fig. 11 and Fig. 12, will be explained. A plate 250 (260) corresponding to the plate 50 (60) is constituted by an extruded frame member. The extruded frame member 250 (260) has plural ribs 255 (265). This extruded frame member 250 (260) is subjected to incremental forming carried out the increment formation. For this purpose reason, the ribs 255 (265) of the upper end portion and the lower end portion of the ribs 255 (265) of the extruded frame member 250 (260) are removed by being cut off.

When the thickness of the plate at the upper end portion and the lower end portion of the extruded frame member 250 (260) and the portion of the side face side of the car body (the portion for providing the flange 252 (262)) is thick and, the face of the rib 255 (265) is cut

off and then the plate thickness becomes to suit for the increment of forming.

To the end portion of the side of the plate 270 and the end portion of the side of the passage 45, the rib 257 (267) is provided. The portion of the end portion 259 of the plate 250 for welding to the end portion of the plate 270 is cut off and the welding use groove is provided. A protrusion size of the rib 257 (267) is smaller than a protrusion size of the rib 255 (265). A groove 258 is provided to a plate of the rib 257 (267). An end portion 259 of the plate is arranged the side of the passage 45 from an end portion of the side of the passage 45 of the rib 257 (267).

In the groove 258, an end portion of an interior member (not shown in figure) and by the provision of the rib 257 (267), a plate thickness of the end portion of the side of the passage 45 is made thick, as a result, the strength corresponding the flange 255 (265) can be secured.

For this reason, the end portion of the side of the passage 45 is not formed with the rib 257 (267), but the plate thickness of the end portion of the passage 45 side can be formed thick. Further, the flange 255 (265) can be provided according to the extrusion processing manner. A thick portion is named generically with the rib 257 (267), the thick plate member and the flange 255 (265).

According to the above-stated embodiment of the present invention, it is unnecessary to provide the member

by bending a flange [by bending the flange] corresponding to the flange 52b (62b). Further, it is unnecessary to provide the recessed portion 53. Accordingly, the plate can be formed easily.

The plate 70 can be formed with [the] an extruded frame member similar to the plate 250. The extrusion direction of the plate 70 is the width direction of the car body. The flange 72b is formed in the thick portion of the plate 250 (260). Further, the combination of the plate 220 to the plate 270 can change the combination of the plate 50 to the plate 70.

In a case where the plate 250 is not constituted by one extruded frame member, [using] it is possible to use plural extruded frame members that are welded. This joining (the welding) can be carried out, for example, [according to the] using friction stir welding [manner]. The plate 270 can be formed [with the] of an extruded frame member.

[The] It is possible to mount a male die [is mounted] on the [row] raw material and [the] bend outer peripheral portion of the [row] raw material [is] using a bent by the tool moving along [to] the outer peripheral portion of the male die [and then] in the flange [can be] manufacture of a manufactured. Further, the plates 50, 60, 70 can be manufactured [according to the] using press processing [manner].

According to the present invention, the two [forming] products having [the] a flange in the end portion of the plate and [the] a third plate can be welded without [the] a gap ([the] clearance).